INDOOR AIR QUALITY ASSESSMENT

Bernardston Town Hall
1 Main Street
Bernardston, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
Emergency Response/Indoor Air Quality Program

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Background/Introduction

At the request of Jack Patch, Town Selectman and Fire Chief, an indoor air quality assessment was done at the Bernardston Town Hall (BTH), 1 Main Street, Bernardston, Massachusetts. This assessment was conducted by the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA). Concerns of chemical odors within the building prompted the request.

On September 24, 2002 a visit was made to this building by Michael Feeney, Director of Emergency Response/Indoor Air Quality (ER/IAQ). Mr. Patch and various other town officials accompanied Mr. Feeney during the assessment. After consultation with Mr. Patch, Mr. Feeney returned to the BTH on September 27, 2002 following reports of new different odors. Mr. Feeney was accompanied by Mr. Patch and several members of the Bernardston Fire Department (BFD) during this follow up visit.

The BTH is a two-story building constructed in 1878. The second floor contains an auditorium. A large attic exists above the auditorium. The first floor was originally constructed with two offices and a large room. The large room was later subdivided to create three offices and a kitchen in the rear of the building. A bell tower and belfry are located at the front of the building. A dirt crawlspace lies beneath the building. The foundation consists of brick on top of stacked flagstone. Heat is provided by a furnace located in a room off the crawlspace. Windows in the building are openable.

Methods

Air tests for carbon dioxide, carbon monoxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor. Screening for total volatile organic compounds (TVOCs) was conducted using a Hnu Photo Ionization Detector (PID).

TVOC measurements were taken in several areas within the BTH. Outdoor TVOC levels were taken as comparison values to indoor levels.

Results

The BTH has an employee population of 5 and an estimated 25-30 other individuals who visit on a daily basis. The tests were taken under normal operating conditions. Test results appear in Table 1. Air samples are listed in the tables by location that the air sample was taken.

Discussion

Ventilation

It can be seen from the table that carbon dioxide levels were below 800 parts per million parts of air [ppm] in all areas surveyed. These carbon dioxide levels are indicative of an adequate fresh air exchange. [Please note, however, that only two people occupied the building during this testing.] Reduced population, open windows and emergency exhaust ventilation used to eject odors can serve to greatly reduce carbon dioxide levels and are not reflective of typical building conditions.

No functioning mechanical ventilation systems exist in the building, with the exception of restroom and kitchen exhausts. Each room has a radiator beneath the window that provides heat. The sole source of fresh air is through openable windows. With the lack of supply and exhaust ventilation, pollutants that exist in the interior space can build up and lead to indoor air quality and comfort complaints.

The second floor contains two air-handling units installed over the stage (see Picture 1). Town employees report that these units have not been used for a period of time. Two abandoned exhaust vents also exist in the building: one to the left of the stage on the second floor (see Picture 2) and the second located on the wall to the left of the kitchen (see Picture 3). Each vent was connected to a cupola on the roof (see Picture 4) via ductwork. Exhaust vents were sealed, possibly as an energy conservation measure. The sealing of these vents prevent their intended operation. At the time of the assessment, the sole operating mechanical exhaust ventilation systems that existed in the building were a stove vent in the kitchen (see Picture 5) and restroom exhaust vents (see Picture 6). With the kitchen and restroom exhaust vents deactivated, no operating mechanical exhaust ventilation exists in this building.

During summer months, ventilation in the town hall is controlled by the use of openable windows. The town hall was configured in a manner to use cross-ventilation to provide comfort for building occupants. The building is equipped with windows on opposing exterior walls. This design allows for airflow to enter an open window (windward side), pass through the interior and exit the building on the leeward side (opposite the windward side) (see Figure 1). With all windows open, airflow can be maintained in a building regardless of the direction of the wind. This system fails if the windows are closed (see Figure 2). In the case of the BTH building, the erection of interior walls to form offices prevents the utilization of cross ventilation when hallway doors are closed. This natural ventilation system was replaced with the installation of window-mounted air conditioners in each office. Each window-mounted air conditioner has minimal capacity to introduce fresh air during operation.

In order to have proper ventilation with a mechanical supply and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air. The date of the last servicing and balancing of these systems was not available at the time of the assessment. It is recommended that HVAC systems be rebalanced every five years. (SMACNA, 1994).

The Massachusetts Building Code requires a minimum ventilation rate of 20 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (BOCA, 1993, SBBRS, 1997). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this occurs a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week based on a time-weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches. For more information concerning carbon dioxide, see Appendix I.

Temperature measurements were in a range of 69^o F to 72^o F, which were very close to the BEHA recommended comfort guidelines. The BEHA recommends that indoor air temperatures be maintained in a range of 70^o F to 78^o F in order to provide comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply. As mentioned previously, fresh air intakes for the AHUs were shut, which can lead to increased temperatures. This results in air being returned to the AHUs to be re-heated. With the fresh air intakes shut, no outside air is introduced into the system creating a closed loop, continually resulting in increased temperatures. It would be expected that with increased occupancy, temperatures would increase even more.

The relative humidity in the building ranged from 28 to 31 percent, which is below the BEHA recommended comfort range in all areas sampled. The BEHA recommends a comfort range of 40 to 60 percent for indoor air relative humidity. Relative humidity levels would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

Building occupants reported noticeable chemical odors on September 17, 2002. A musty odor was detected upon entry of the building through the front door of the town hall during the September 24, 2002 visit. The odor was attributed to a carpet installed on plywood (see Pictures 7 and 7A) in the front foyer. BEHA staff suggested to Bernardston town officials that the carpet be removed to eliminate the musty odor.

As previously mentioned, BEHA staff returned to the building on September 27, 2002 due to reports of different odors described as "a smoke/plywood-sawing odor". This visit was done in the company of BFD personnel since the odor may have been associated with an electrical system short scorching wood. An examination of the crawlspace by both BEHA and BFD ruled out an electrical system problem in the crawlspace since no damaged wire or scorched wood was identified.

Without electrical/scorching damage, the investigation focused on the foyer plywood floor, which was the area identified by building occupants as the locus of odors. At the suggestion of BEHA staff, the panel of plywood was removed from the floor. The process resulted in the production of wood chips splintered from the plywood sheet. Town hall personnel present outdoors during this process reported that a wood chip taken from the floor had an identical odor to that reported. Based on this anecdotal report and the consensus of BEHA staff, BFD personnel and Bernardston town officials a section of the foyer plywood floor was removed. The underside of a removed plywood sheet showed signs of accumulated dirt and/or mold growth (see Picture 8). The plywood sheeting covered a hole in the original floorboards, which was open to the dirt floor crawlspace (see Picture 9). There are a number of conditions/circumstances that indicate materials off gassing from the plywood floor may be the source of odors reported in the building. These include:

1. Plywood is made using an adhesive that consists of urea-formaldehyde resin (US EPA and US CPSC, 1995). Under conditions of increased temperature and humidity indoors, the urea-formaldehyde resin can breakdown, releasing

formaldehyde vapor. Formaldehyde is a volatile organic compound (VOC) that can cause irritation to the eyes, nose and throat.

2. During the spring and summer of 2002, New England experienced a stretch of excessively humid weather during three periods in May, July and August. As an example, outdoor relative humidity at various times ranged from 73 percent to 100 percent without precipitation from July 4, 2002 through July 12, 2002 (The Weather Underground, 2002). According the American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE), if relative humidity exceeds 70 percent, mold growth may occur due to wetting of building materials (ASHRAE, 1989).
3. The front foyer is not air-conditioned and exists over a dirt floor crawlspace with no mechanical or passive ventilation. During the September 24 visit, all areas measured within the building had relative humidity measurements 2 to 7 percent higher than the relative humidity measured outdoors (43%). Increased temperature indoors, as measured in this building, would be expected to have lower relative humidity compared to outdoors. This increase in relative humidity may indicate that a moisture source exists in the building. One possible source of increased relative humidity is occupants in a building without adequate air exchange. This possibility was ruled out since that building was under active exhaust ventilation (to remove odors) with the front door open and only two individuals within the building. The highest relative humidity measurement was within the tax collector's office. The tax collector's office is the only office that has a hatchway to the crawlspace.

4. The building has a peaked roof without gutters and downspouts (see Picture 10). Rainwater pools at the base of the building on the east exterior wall of the building and on tarmac that splashes onto the foundation (as indicated by moss growth on brick). The foundation consists of brick installed over piled flagstone (see Picture 11). The composition of the foundation can make it prone to water penetration.
5. No means to vent the crawlspace exists. In an effort to improve energy efficiency, foil-faced fiberglass insulation was affixed to the foundation walls. It appears the purpose of the insulation is to prevent air penetration and heat loss through the foundation. The installation of insulation also prevents natural ventilation of the crawlspace that can lead to the accumulation of water vapor.
6. Shrubbery exists in close proximity to the foundation walls (see Picture 12). The growth of roots against the exterior walls can bring moisture in contact with wall brick and eventually lead to cracks and/or fissures in the foundation below ground level. Over time, this process can undermine the integrity of the building envelope and provide a means of water entry into the building through capillary action through foundation concrete and masonry (Lstiburek, J. & Brennan, T.; 2001).

Each of these conditions, in combination with high ambient temperature during the summer, increased relative humidity and possible water sources within the crawlspace, may contribute to moistening of the plywood resulting in possible formaldehyde release.

Exacerbating this is the configuration of the plywood installed in the foyer. Each plywood sheet affixed to the existing floor formed an arch due to the lack of uniformity of the floor level. This arch created spaces between the plywood sheet and original floor, in which materials (dirt, water vapor and other crawlspace materials) could accumulate. These materials are likely to be expelled through spaces in the plywood as individuals walked through the foyer, each step creating a bellows-like effect that forced particulate and other materials into the existing carpet or foyer. Removing the foyer carpet revealed the potential for wetting of this carpet by crawlspace moisture. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends that porous materials (e.g., carpet) be dried with fans and heating within 24 hours of becoming wet (US EPA, 2001, ACGIH, 1989). If porous materials are not dried within this time frame, mold growth may occur.

In order to explain how mold and associated odors/particulates in the crawlspace can migrate into occupied areas, the following concepts must be understood:

1. Heated air (from radiators) will create upward air movement (called the stack effect).
2. Cold air moves to hot air, which creates drafts.
3. As the heated air rises, negative pressure is created, which draws cold air to the heat source.
4. Airflow created by the stack effect, drafts or mechanical ventilation can draw airborne particulates into the air stream (i.e. from the crawlspace).
5. The operation of the kitchen exhaust fan will tend to depressurize the first floor, which can draw air from the crawlspace when all windows and doors are *closed*.

Each of these concepts have an influence on the movement of crawlspace odors or other particulates into cavities beneath the plywood, through the crawlspace plug in the tax collectors office or through wall/floor penetrations in the crawlspace. In order to control possible mold growth, water penetration into the basement area must be minimized.

Control of water penetration through the foundation can be limited by installing gutters and permanently rendering watertight former window frames in the basement.

A musty odor was detected in the Board of Health Office. The walls of this office are decorated with carpeting. As relative humidity levels increase indoors, porous building materials, such carpeting can absorb moisture. The moisture content in carpet can fluctuate with increases/decreases in indoor relative humidity and temperature. Therefore, it is important that moist outdoor air introduced into the interior be removed.

Several rooms contained a number of plants. Plant soil and drip pans can also provide a source of mold growth. Over-watering of plants should be avoided and drip pans should be inspected periodically for mold growth.

Other Concerns

Other potential sources of irritants included the use of different custodial products (solvent containing cleaners and pesticides). It was reported that the elder affairs office that was located on the first floor was moved from the building on Monday, September 23, 2002. The floor of this newly vacated area was thoroughly cleaned with several products (Spartan Damp Mop Detergent Concentrate, Accumix Neutral Cleaner and Accumix Stride SC). In addition, it was reported that a pesticide (BugOut Housefly Spray) was also applied in several areas.

In an effort to identify whether residual chemicals (specifically VOCs) remained within the building from application of these products, air monitoring for aerosolized materials was conducted. TVOCs are groups of substances containing carbon that have the ability to evaporate at room temperature. Frequently, exposure to low levels of TVOCs may produce eye, nose, throat and/or respiratory irritation in some sensitive individuals. For example, if a chemical were present that was evaporating at room temperature from tile adhesive, the most likely materials would be TVOCs. An outdoor air sample in front of the building was taken for comparison (TVOC concentration outdoors was measured at 0.5 ppm). All indoor TVOC concentrations on floors, above desks and other building areas were equivalent to outdoor concentrations measured, indicating that no residual sources of TVOCs from these chemicals exist in the building.

Each cleaning product was also tested using the PID for TVOCs. Each cleaner produced measurable levels of TVOCs when the probe of the PID was placed over an open container. The lack of mechanical ventilation within the building exacerbates odors from the use of these materials.

A number of areas contain wall-mounted air conditioners. Each wall-mounted air conditioner has the means to introduce minimal fresh air from outdoors but no capacity to exhaust air. The operation of air conditioners recirculates cleaner or pesticide constituents. The sole means for removing odor from the building was the kitchen exhaust fan (see Picture 5). After the elder affairs program moved from the building, the use of the fan was ceased, preventing the venting of cleaning/pesticide constituents from the building. The use of these products requires adequate ventilation.

BTH staff reported that insecticides were used in this building to help combat the insect problem. Insecticides contain chemicals that can be irritating to the eyes, nose and throat. A can of pyrethrin-based insecticide was seen in custodial closet. Pyrethrins have been associated with cross sensitivity with individuals who have ragweed allergy (EPA, 1989). Applicators of this product should be in full compliance with the federal and state rules and regulations that govern pesticide use including posting and notification requirements (333 CMR 13.10). Under no circumstances should untrained personnel apply this material. This product should not be applied prior to or during business hours. If application must be done during the workweek, this material should be applied shortly after the workday ends, in order to give the applied areas ample time to dry. Under current Massachusetts law that will go into effect November 1, 2001, the principles of integrated pest management (IPM) must be used to remove pests in state buildings (Mass Act, 2000). A copy of the IPM guide can be downloaded from the Internet at: http://www.state.ma.us/dfa/pesticides/publications/IPM_kit_for_bldg_mgrs.pdf.

Bird Wastes and Other Concerns

Of note was the accumulation of bird skeletons and wastes observed inside an abandoned exhaust vent in the auditorium and attic (see Pictures 13 and 14). Town officials reported a heavy bird infestation inside the attic of the building. Bird wastes in a building raise concerns over diseases that may be caused by exposure to bird wastes. These conditions warrant clean up of bird waste and appropriate disinfection. Certain molds are associated with bird waste and are of concern for immune compromised individuals. Diseases of the respiratory tract may also result from exposure to bird waste. Exposure to bird wastes is thought to be associated with the development of hypersensitivity pneumonitis in some individuals. Psittacosis (bird fancier's disease) is another condition closely associated with exposure to bird wastes in bird raising and other occupational settings. While immune compromised individuals have an increased risk of health impacts following exposure to the materials in bird wastes, these impacts may also occur in healthy individuals exposed to these materials.

The methods to be employed in clean up of a bird waste problem depends on the amount of waste and the types of materials contaminated. The MDPH has been involved in several indoor air investigations where bird waste has accumulated within ventilation ductwork. Accumulation of bird wastes have required clean up of such buildings by a professional cleaning contractor. In less severe cases, the cleaning of the contaminated material with a solution of sodium hypochlorite has been an effective disinfectant (CDC, 1998). Disinfection of non-porous materials can be readily accomplished with this material. Porous materials contaminated with bird waste should be examined by a professional restoration contractor to determine if the material is salvageable. Where a porous material has been colonized with mold, it is recommended that the material be discarded (ACGIH, 1989).

The protection of both the cleaner and other occupants present in the building must be considered as part of the overall remedial plan. Where cleaning solutions are to be used, the "cleaner" is required to be trained in the use of personal protective methods and equipment (to prevent either the spread of disease from the bird wastes and/or exposure to cleaning chemicals). In addition, the method used to clean up bird waste may result in the aerosolization of particulates that can spread to occupied areas via openings (doors, etc.) or by the ventilation system. Methods to prevent the spread of bird waste particulates to occupied areas or into ventilation ducts must be employed. In these instances, the result can be similar to the spread of renovation-generated dusts and odors in occupied areas. To prevent this, the cleaner should employ the methods listed in the SMACNA Guidelines for Containment of Renovation in Occupied Buildings (SMACNA, 1995).

Conclusions/Recommendations

The conditions observed in the BTH raise a number of issues. The abandonment of the mechanical ventilation system in the building makes it difficult to exchange air in the building. Without mechanical ventilation, the constituents of custodial products can linger in the building. With water pooling near the foundation of the building, moisture can penetrate into and linger within the crawlspace. The excessive relative humidity during this past summer moistened porous materials, leading to possible mold growth and release of formaldehyde from plywood flooring. With air exchange limited, normally occurring pollutants can build up, unless an operating ventilation system exists to dilute these materials by supplying fresh air while removing pollutants through exhaust ventilation. Since this building does not have mechanical exhaust ventilation, odors, particulates and other materials can build up in the indoor environment.

In order to address the conditions listed in this assessment, the recommendations made to improve indoor air quality are divided into **short-term** and **long-term** corrective measures. The short-term recommendations can be implemented as soon as practicable. Long-term solution measures are more complex and will require planning and resources to adequately address overall indoor air quality concerns. In view of the findings at the time of this visit, the following recommendations are made:

Short Term Recommendations:

1) Remove carpet from foyer (already accomplished).
2) Seal plywood sheet seams with duct tape (already accomplished) (see Picture 7A).

3) Remove the plywood flooring in the foyer. Replace with a material with continuous, sealed seams to prevent crawlspace air from penetrating into occupied areas.

4) Seal floor penetrations on first floor (e.g., heating pipes) with an appropriate, fire-rated sealing compound to prevent crawlspace air from penetrating into occupied areas.

5) To prevent moisture penetration into the crawlspace, the following actions should be considered:

   a) Install gutters and downspouts to direct rainwater at least five feet away from the foundation.

   b) Remove foliage to no less than five feet from the foundation.

   c) Improve the grading of the ground away from the foundation at a rate of 6 inches per every 10 feet (Lstiburek, J. & Brennan, T.; 2001).

   d) Install a water impermeable layer on ground surface (clay cap) to prevent water saturation of ground near foundation (Lstiburek, J. & Brennan, T.; 2001).

6) Discard carpets shown in Picture 15.

7) Operate the kitchen exhaust vent during business hours, regardless of cooking activities.

8) Have bird waste cleaned from attic and exhaust vents.

9) Examine the fiberglass insulation along foundation exterior for moisture or mold colonization. If mold growth is present, replace the fiberglass. Please refer to recommendation #4 prior to acting on this recommendation.

10) For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can

be enhanced when the relative humidity is low. To control for dusts, a HEPA filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Drinking water during the day can help ease some symptoms associated with a dry environment (e.g., throat and sinus irritations).

11) Examine drip pans for mold growth and disinfect with an appropriate antimicrobial where necessary. Consider reducing the number of plants in certain areas.

12) Avoid using custodial cleaners containing TVOCs. Acquire current Material Safety Data Sheets for all products that contain hazardous materials and are used within the building, including office supplies, in conformance with the Massachusetts Right-To-Know Law, M.G.L. c. 111F (MGL, 1983).

13) Clean window-mounted air conditioner filters regularly.

14) Seal around trap door with an appropriate material to prevent crawlspace odors from penetrating into the tax collectors office.

15) Use IPM to remove pests from the building. Activities that can be used to eliminate pest infestation may include the following activities.

    a) Consult a licensed pesticide applicator on the most appropriate method to end infestation.

    b) Reduction/elimination of pathways/food sources that are attracting pests.

    c) Reduce harborages (plants/cardboard boxes) where pests may reside.

The following **long-term** measures should be considered. A ventilation engineer should be consulted to resolve air supply/exhaust ventilation issues building-wide.

1. In combination with the installation of gutters and downspouts, the installation of a drainage system may also be necessary to direct water away from the base of the foundation.

2. Consult a building engineer concerning the most appropriate method to provide active mechanical exhaust ventilation to place the crawlspace under negative pressure. Placing the crawlspace under negative pressure will reverse air penetration into occupied spaces. Please note that a crawlspace exhaust vent should not expel crawlspace air near univent fresh air intakes.

3. Examine each AHU for function. Repair AHUs if feasible and operate during business hours. Check fresh air intakes for repair and increase the percentage of fresh air intake if necessary.

4. Examine the feasibility of restoring exhaust ventilation system. Operate exhaust vents during business hours. Please note that steps to remove bird waste from vents should be done prior to any work on this system. Once fresh air supply is increased, the ventilation system should be balanced by an HVAC engineering firm.

5. Consider consulting a building engineer to determine the most appropriate method to insulate and install a vapor barrier for the crawlspace. This activity may include:

    - removing insulation from foundation walls;
    - installing insulation to underside of the floor/crawlspace ceiling;
    - insulating water and drainpipes.

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Figure 1 **Cross Ventilation in a Building Using Open Windows and Transoms**

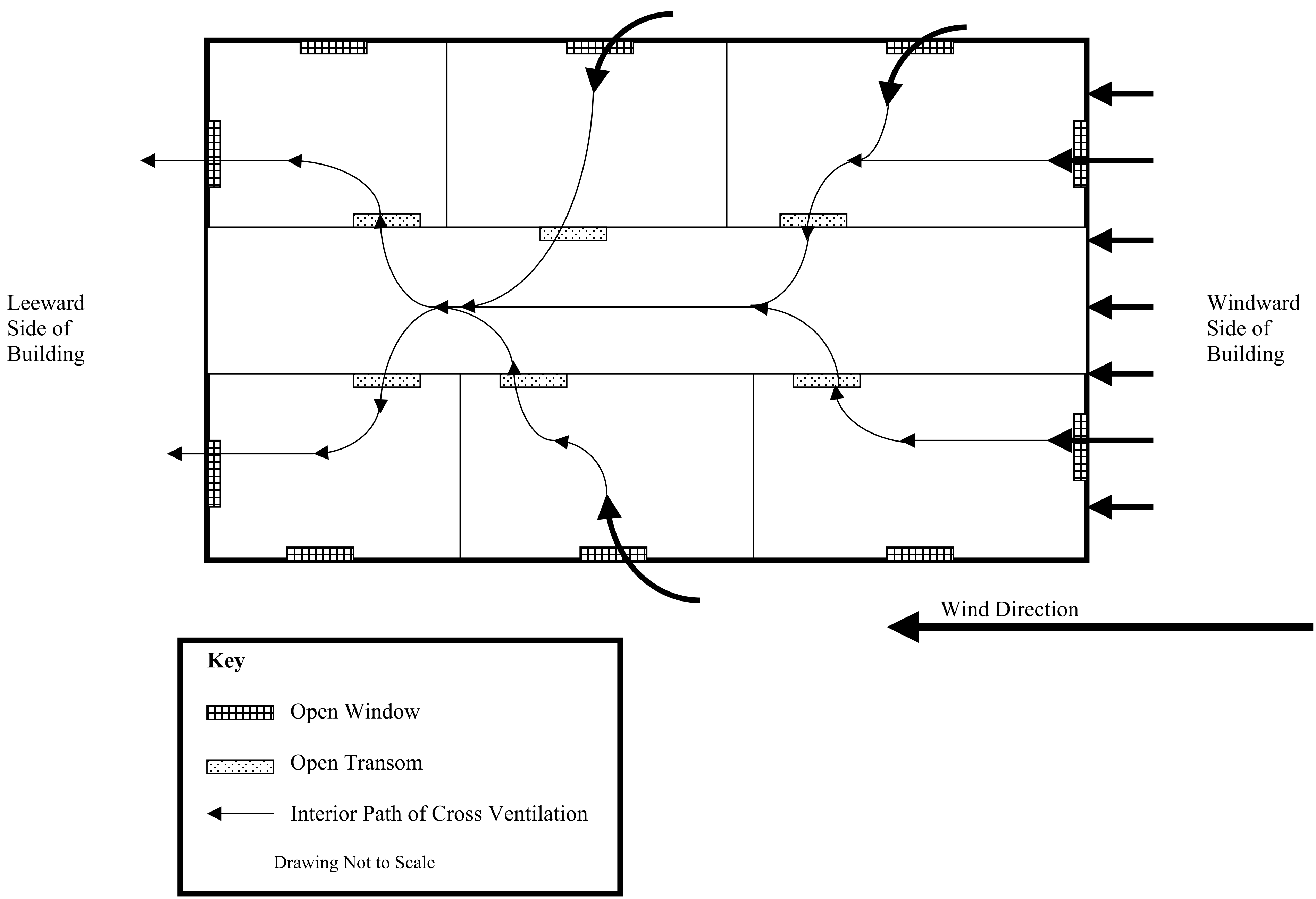
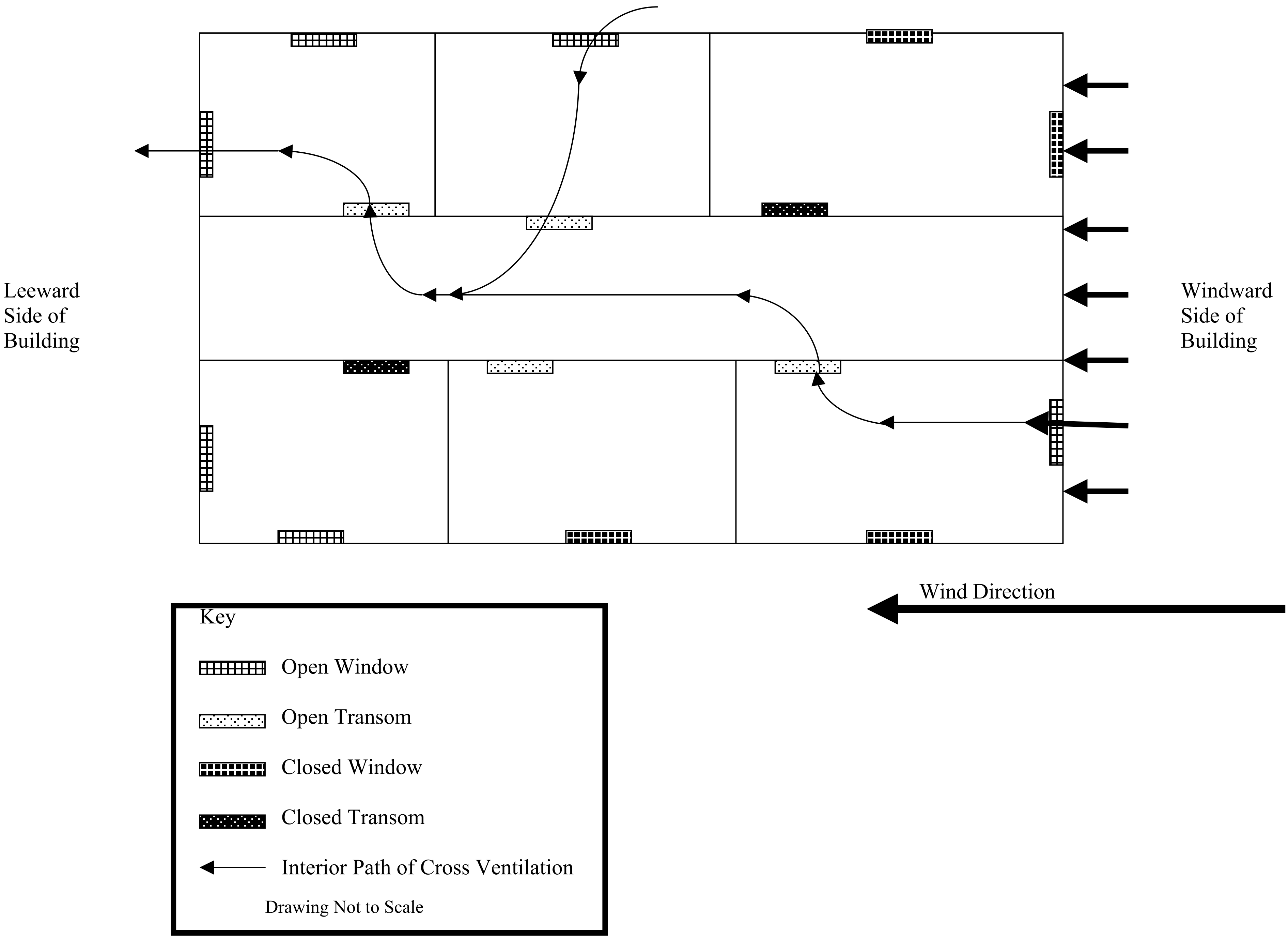
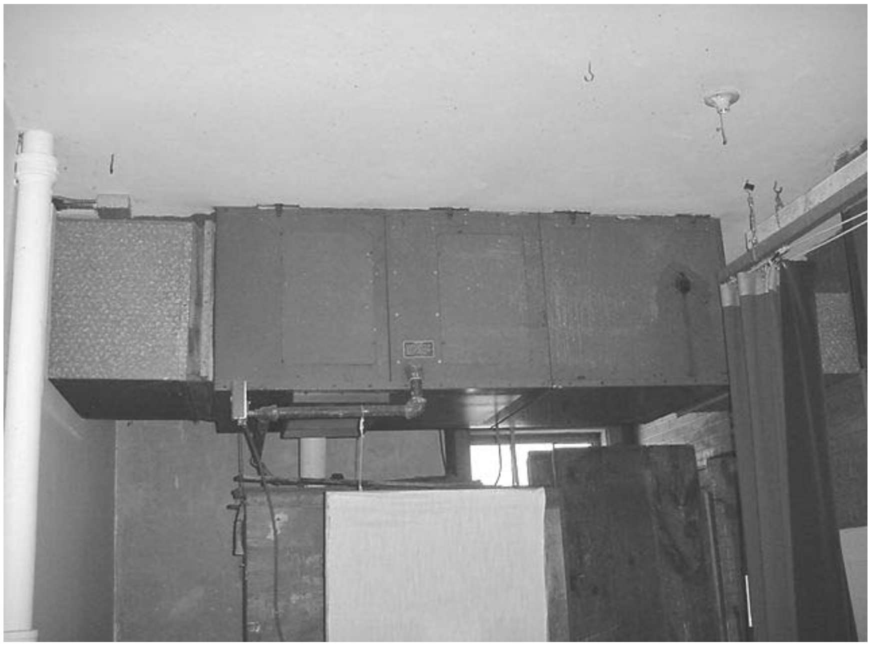


Figure 2 **Inhibition of Cross Ventilation in a Building with Several Windows and Transoms Closed**



Picture 1

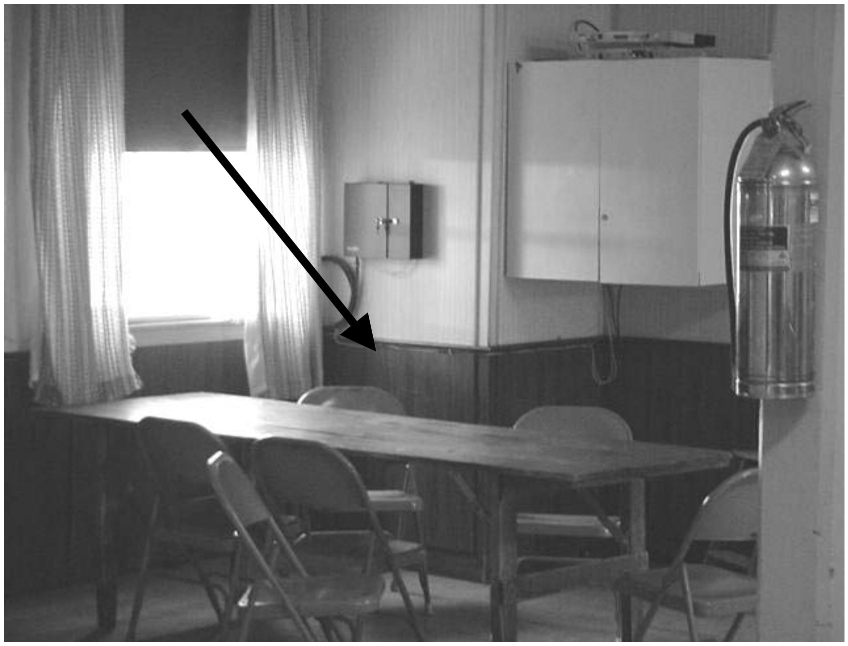


AHUs over stage on 2nd floor

Picture 2

Abandoned Exhaust Vent in Auditorium

Picture 3



Location of Walled-over Vent on 1st floor

Picture 4

Cupola on Roof that is Exhaust Ventilation System Terminus

Picture 5

Exhaust vent in kitchen

Picture 6

Restroom Exhaust Vent Terminus on Exterior Wall

Picture 7

Plywood Foyer Floor Prior to Carpet Removal

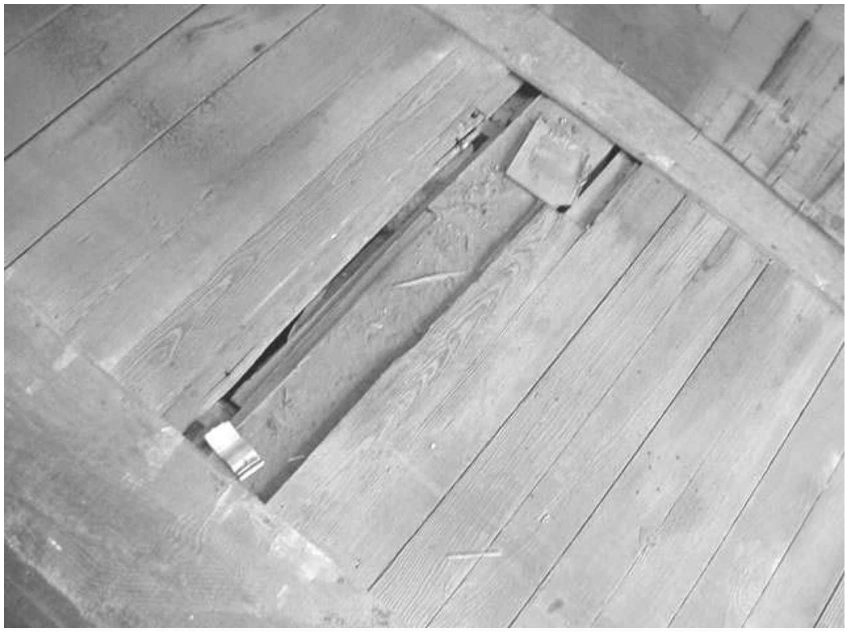
Picture 7A

Plywood Foyer Floor Subsequent to Carpet Removal

Picture 8

Plywood with Accumulated Dirt and/or Mold Colonization

Picture 9



Hole in Original Floor Boards Open to Crawlspace, Covered with Plywood

Picture 10

Pitched Roof Edge without Gutter/Downspout System

Picture 11

Brick/Flagstone Foundation of Town Hall

Picture 12

Shrubbery in Close Proximity to Foundation

Picture 13

Floor of Auditorium Exhaust Vent

Picture 14

Bird Skeleton in Attic

Picture 15

Non-fixed Carpets Removed from 1st Floor Hallway

TABLE 1

Indoor Air Test Results
Bernardston Town Hall September 24, 2002

Location	Carbon Dioxide *ppm	Carbon Monoxide	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
							Intake	Exhaust	
Main Hall	458	0	73	46	0	Y	N	N	Window-mounted AC (WAC) on Radiator, exhaust sealed
Board of Health	360	0	74	46	0	Y	N	N	Door open Radiator
Selectman	402	0	74	47	1	Y	N	N	Radiators-holes to crawlspace WAC off, radiator
Tax Collector	388	0	74	49	0	Y	N	N	Crawl space door – radiator Vacuum closet - plants
Assessors	441	0	74	47	0	Y	N	N	WAC off, door open, radiator
Auditorium	357	0	75	46	0	Y	N	N	Intake off, exhaust blocked 10 CT water damaged (old) Doors to WAC – workshop
Attic									Pigeon carcasses
Town Clerk	336	0	75	45	0	Y	Y	N	WAC off
Kitchen	354		75	45	0	Y	Y	Y	Gas stove - refrigerator
Outdoors	308	0	73	43					

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred 600 - 800 ppm = acceptable > 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%